U.S. FISH AND WILDLIFE SERVICE
SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

SCIENTIFIC NAME: *Geranium hillebrandii*

COMMON NAME: Nohoanu

LEAD REGION: Region 1

INFORMATION CURRENT AS OF: July 2005

STATUS/ACTION:

___ Species assessment - determined species did not meet the definition of endangered or threatened under the Act and, therefore, was not elevated to Candidate status

___ New candidate

_X__ Continuing candidate

___ Non-petitioned

_X__ Petitioned - Date petition received: May 11, 2004

__ 90-day positive - FR date:

_X_ 12-month warranted but precluded - FR date: May 11, 2005

_N_ Did the petition request a reclassification of a listed species?

FOR PETITIONED CANDIDATE SPECIES:

a. Is listing warranted (if yes, see summary of threats below)? yes

b. To date, has publication of a proposal to list been precluded by other higher priority listing actions? yes

c. If the answer to a. and b. is "yes", provide an explanation of why the action is precluded. We find that the immediate issuance of a proposed rule and timely promulgation of a final rule for this species has been, for the preceding 12 months, and continues to be, precluded by higher priority listing actions. During the past 12 months, most of our national listing budget has been consumed by work on various listing actions to comply with court orders and court-approved settlement agreements, meeting statutory deadlines for petition findings or listing determinations, emergency listing evaluations and determinations and essential litigation-related, administrative, and program management tasks. We will continue to monitor the status of this species as new information becomes available. This review will determine if a change in status is warranted, including the need to make prompt use of emergency listing procedures. For information on listing actions taken over the past 12 months, see the discussion of "Progress on Revising the Lists," in the current CNOR which can be viewed on our Internet website (http://endangered.fws.gov).

___ Listing priority change

Former LP: ___

New LP: ___

Date when the species first became a Candidate (as currently defined): 1999 (as *Geranium humile*)

___ Candidate removal: Former LP: __

___ A – Taxon is more abundant or widespread than previously believed or not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status.
___U – Taxon not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status due, in part or totally, to conservation efforts that remove or reduce the threats to the species.
___ F – Range is no longer a U.S. territory.
___ I – Insufficient information exists on biological vulnerability and threats to support listing.
___ M – Taxon mistakenly included in past notice of review.
___ N – Taxon does not meet the Act's definition of "species."
___ X – Taxon believed to be extinct.

ANIMAL/PLANT GROUP AND FAMILY: Flowering plants, Geraniaceae (Geranium family)

HISTORICAL STATES/TERRITORIES/COUNTRIES OF OCCURRENCE: Hawaii, island of Maui
CURRENT STATES/ COUNTIES/TERRITORIES/COUNTRIES OF OCCURRENCE: Hawaii, island of Maui

LAND OWNERSHIP: *Geranium hillebrandii* occurs on State and private lands.

LEAD REGION CONTACT: Paul Phifer, 503-872-2823, paul_phifer@fws.gov

LEAD FIELD OFFICE CONTACT: Pacific Islands Fish and Wildlife Office, Christa Russell, 808-792-9400, christa_russell@fws.gov

BIOLOGICAL INFORMATION:
Species Description *Geranium hillebrandii* is a decumbent subshrub with stems that are dark reddish brown to nearly black, growing embedded in moss mats or other bog plants, often rooting at the nodes, and 5 to 10 decimeters (1.6 to 3.3 feet) long. Leaves are alternate, elliptic to elliptic-cuneate, 1.5 to 2.6 centimeters (0.6 to 1.0 inches) long, 0.9 to 1.5 centimeters (0.4 to 0.6 inchesde, with the upper surface pubescent on veins, the lower surface densely grayish silky strigose, and the margins entire except the apex, which is five- to seven-toothed. Flowers usually are three to four in terminal cymes that project beyond the leaves. The petals are white with purple veins and 10 to 15 millimeters (0.4 to 0.6 inches) long. Carpel bodies are 3 millimeters (0.12 inches) long and densely pubescent. Seeds are one per cell, dark reddish brown, oblong-obovoid, 2.5 millimeters (0.1 inches) long, and have a reticulate surface (Wagner *et al*. 1999a).

Taxonomy *Geranium hillebrandii* was described by C. Aedo and F. Munoz Garmendia. Treated as *G. humile* in the 1999 edition of Wagner *et al.*, this species has been returned to *G. hillebrandii* as a distinct taxon in the supplement to the Manual of the Flowering Plants of Hawaii (2003), the most recently accepted treatment of Hawaiian plants.

Habitat *Geranium hillebrandii* is found in bogs at elevations between 1,490 and 1,770 meters (4,889 and 5,807 feet) (Wagner *et al*. 1999a).

Historical and Current Range/Current Status Historically rare, *Geranium hillebrandii* was restricted to bogs in west Maui. Previously known from two populations totaling approximately 500 individuals, it is currently known from over 2,000 individuals; the result of more thorough surveys (Randy Bartlett, Maui Land and Pineapple Company, pers. comm. 1996; Robert Hobdy, Hawaii Division of Forestry and Wildlife, pers. comm. 1996; Hank Oppenheimer, Maui Land and Pineapple Company, pers. comm. 2004 and 2005).
THREATS:

A. The present or threatened destruction, modification, or curtailment of its habitat or range.
This species is threatened by feral pigs (*Sus scrofa*) that degrade and destroy habitat. As early as 1778, European explorers introduced livestock, which became feral, increased in number and range, and caused significant changes to the natural environment of Hawaii. Past and present activities of introduced alien mammals are the primary factor altering and degrading vegetation and habitat on Maui. Pigs are currently present on Maui and four other islands, and inhabit rain forests and grasslands. While rooting in the ground in search of the invertebrates and plant material they eat, feral pigs disturb and destroy vegetative cover, trample plants and seedlings, and threaten forest regeneration by damaging seeds and seedlings. They disturb soil and cause erosion, especially on slopes. Alien plant seeds are dispersed on their hooves and coats as well as through their digestive tracts, and the disturbed soil is fertilized by their feces, helping these plants to establish. Pigs are a major vector in the spread of many introduced plant species. Feral ungulates trample and eat native vegetation and disturb and open areas. This causes erosion and allows the entry of alien plant species (Cuddihy and Stone 1990; Medeiros *et al*. 1986; Wagner *et al*. 1999a). Pig exclusion fences protect some of the known individuals of this species; however, without continued monitoring and maintenance of those fences, pigs from surrounding areas can easily access fenced areas. In addition, the remaining, unfenced individuals of this taxon are still impacted by this threat.

B. Overutilization for commercial, recreational, scientific, or educational purposes.
None known.

C. Disease or predation.
Because Hawaii's native plants evolved without any browsing or grazing mammals present, many lost natural defenses to such impacts (Carlquist 1980, Lamoureux 1994). Browsing by ungulates has been observed on many other native species, including common and rare or endangered species (Cuddihy and Stone 1990; Loope *et al.* 1991). Therefore, even though there are no observations of browsing for this species, it is likely that pigs impact this species directly as well as their indirect impacts to the surrounding habitat.

D. The inadequacy of existing regulatory mechanisms.
Pigs are managed as a game animal in Hawaii. Pig hunting is allowed on all islands either year-round or during certain months, depending on the area (Hawaii, Department of Land and Natural Resources n.d.-a, n.d.-b, n.d.-c). However, public hunting does not adequately control the

number of ungulates to eliminate this threat to native plant species. Pig exclusion fences protect some of the known individuals of this species; however, without continued monitoring and maintenance of those fences, pigs from surrounding areas can easily access fenced areas. In addition, the remaining, unfenced individuals of this taxon are still impacted by this threat.

E. Other natural or manmade factors affecting its continued existence.
Alien plant species are a major threat to this species (discussed below) (Marie Bruegmann and Jeff Burgett, U.S. Fish and Wildlife Service (Service), pers. comms. 1996). The original native flora of Hawaii consisted of about 1,400 species, nearly 90 percent of which were endemic. Of the total native and naturalized Hawaiian flora of 1,817 taxa, 47 percent were introduced from other parts of the world, and nearly 100 species have become pests (Smith 1985; Wagner *et al*. 1999a). Confirmed personal observations (M. Bruegmann and J. Burgett, pers. comms. 1996) and several studies (Cuddihy and Stone 1990; Wood and Perlman 1997; Robichaux *et al*. 1998) indicate nonnative plant species may outcompete native plants similar to *Geranium hillebrandii*. Competition may be for space, light, water, or nutrients, or there may be a chemical inhibition of other plants (Smith 1985; Cuddihy and Stone 1990). In addition, nonnative pest plants found in habitat similar to that of this species have been shown to make the habitat less suitable for native species (Smathers and Gardner 1978; Smith 1985; Loope and Medeiros 1992; Medeiros *et al.* 1992; Ellshoff *et al.* 1995; Meyer and Florence 1996; Medeiros *et al.* 1997; Loope *et al*. 2004). In particular, alien pest plant species modify habitat by modifying availability of light, altering soil-water regimes, modifying nutrient cycling, or altering fire characteristics of native plant communities (Smith 1985; Cuddihy and Stone 1990; Vitousek *et al*. 1987). Because of demonstrated habitat modification and resource competition by nonnative plant species in habitat similar to the bog habitat of this species, the Service believes nonnative plant species are a threat to *G. hillebrandii*. Nonnative plants are being controlled in some of the known populations of this species, but will probably never be completely eradicated because new propagules are constantly being dispersed into the fenced area from surrounding, unmanaged lands. Currently, many widespread alien taxa cannot be completely eradicated from Maui, and therefore are expected to continue dispersing into previously managed areas (Loope 1998, Smith 1985). The remaining populations of *G. hillebrandii* are still impacted by this threat.

The primary alien plant species threat to *Geranium hillebrandii* on Puu Kukui is *Tibouchina herbacea* (glorybush) (M. Bruegmann and J. Burgett, pers. comm. 1996). Glorybush first became established on the island of Hawaii in the late 1970s and, by 1986, was collected on west Maui (Almeda 1999). Although the disruptive potential of this alien plant is not fully known, glorybush appears to be invading mesic and wet forests of Hawaii (R. Bartlett, pers. comm. 1996). Other alien plant species that may threaten *Geranium hillebrandii* on Puu Kukui include the rush *Juncus planifolius, J. effusus* (Japanese mat rush), and *Rubus argutus* (prickly Florida blackberry) (M. Bruegmann and J. Burgett, pers. comm. 1996).

CONSERVATION MEASURES PLANNED OR IMPLEMENTED
The State of Hawaii and private landowners have initiated ungulate control and weed control in some of the areas where this species occurs. Construction of an ungulate exclosure fence in the Kahakuloa Game Management Area on Maui, funded through a Service grant to the State Division of Forestry and Wildlife, will protect individuals of *Geranium hillebrandii* in this area

(Maui Pineapple Company, Ltd. 1999). The fence construction began in August 2004 and is ongoing. In addition, the West Maui Watershed Partnership, a non-governmental, non-profit partnership composed of west Maui landowners and managers, received funding from the Service over the last five years for ungulate exclosure fences, which have been completed, and ungulate and nonnative plant control, which is ongoing. These actions provide protection to the individuals of *G. hillebrandii* in the fenced areas in the west Maui mountains.

SUMMARY OF THREATS

The major threats to this taxon are pigs and nonnative plant species, which are believed to be a major cause of the decline of this species throughout its range. Feral pigs have been fenced out of some of the populations where *Geranium hillebrandii* currently occurs, but the fences must be continually maintained to prevent incursion. Nonnative plants have been reduced in the populations that are fenced. These on-going conservation efforts for this species benefit only some of the known populations. The other populations are still impacted by these threats and will require long-term monitoring and management to maintain threat free areas.

LISTING PRIORITY:

THREAT			
Magnitude	Immediacy	Taxonomy	Priority
High	Imminent	Monotypic genus	1
		Species	2
		Subspecies/population	3
	Non-imminent	Monotypic genus	4
		Species	5
		Subspecies/population	6
Moderate to Low	**Imminent**	Monotypic genus	7
		Species	**8***
		Subspecies/population	9
	Non-imminent	Monotypic genus	10
		Species	11
		Subspecies/population	12

Rationale for listing priority number:

Magnitude:

This species is moderately threatened by pigs that degrade and destroy habitat, and by nonnative plants that outcompete and displace it. Threats to montane bog habitat of *Geranium hillebrandii* occur over most of its range and are expected to continue or increase without control or eradication. Feral pigs have been fenced out of some of the populations where *Geranium hillebrandii* currently occurs, but the fences must be continually maintained to prevent incursion. Nonnative plants have been reduced in the populations that are fenced. These on-going conservation efforts for this species benefit only some of the known populations. The other

populations of this species are still impacted by these threats and will require long-term monitoring and management to maintain threat free areas. The magnitude of the threats from feral pigs and nonnative plants is moderate, not high, to the 2,000+ individuals of this species in the montane bogs of west Maui. Some of the populations are protected by fences and active weeding is conducted in the fenced areas.

Imminence:
Threats to *Geranium hillebrandii* from pigs and nonnative plants are imminent because they are ongoing in the unfenced populations.

Yes Have you promptly reviewed all of the information received regarding the species for the purpose of determining whether emergency listing is needed?

Is Emergency Listing Warranted? No. The species does not appear to be appropriate for emergency listing at this time because the immediacy of the threats is not so great as to imperil a significant proportion of the taxon within the time frame of the routine listing process. In addition, individuals of *Geranium hillebrandii* are benefiting from conservation actions by the State Division of Forestry and Wildlife, private landowners, and the West Maui Watershed Partnership, and funded in part by the Service. These conservation actions include ungulate exclosure fences in the Kahakuloa Game Management Area, and fencing and control of nonnative plants and ungulates in the west Maui mountains. If it becomes apparent that the routine listing process is not sufficient to prevent large losses that may result in this species' extinction, then the emergency rule process for this species will be initiated. We will continue to monitor the status of *G. hillebrandii* as new information becomes available. This review will determine if a change in status is warranted, including the need to make prompt use of emergency listing procedures.

DESCRIPTION OF MONITORING:
Much of the information in this form is based on the results of a meeting of 20 botanical experts held by the Center for Plant Conservation in December of 1995 and November 1996, and was updated by personal communication with Randy Bartlett of Maui Land and Pineapple Company in 1996, Robert Hobdy of the Hawaii Division of Forestry and Wildlife in 1996, and Marie Bruegmann and Jeff Burgett of the U.S. Fish and Wildlife Service in 1996. We have incorporated additional information on this species from our files and the most recent supplement to the *Manual of the Flowering Plants of Hawaii* (Wagner and Herbst 2003). In 2004, the Pacific Islands office contacted the following species experts: Bob Hobdy, retired from Hawaii Division of Forestry and Wildlife; Joel Lau, Hawaii Natural Heritage Program; Art Medeiros, U.S.G.S. Biological Resources Discipline; Hank Oppenheimer, resource manager for Maui Land and Pineapple Company; and Steve Perlman and Ken Wood, National Tropical Botanical Garden. New information on range and status was provided in 2004. In 2005 we contacted the species experts listed below, but received no new information on this taxon.

The Hawaii Natural Heritage Program identified this species as critically imperiled (Hawaii Natural Heritage Program Database 2004). Based on the International Union for Conservation of Nature and Natural Resources Red Plant Data Book rarity categories, this species is

recognized as Rare (could be at risk) by Wagner *et al.* (1999b).

One species expert provided new information confirming the status of the species this year and the results are included in this assessment.

COORDINATION WITH STATES

In October 2004 we provided the Hawaii Division of Forestry and Wildlife with copies of our most recent candidate assessments for their review and comment. Vickie Caraway, the State botanist, reviewed the information for this species and provided no additional information or corrections (V. Caraway, pers. comm. 2005).

LITERATURE CITED

List all experts contacted:

Name	Date	Place of Employment
1. Joel Lau	June 28, 2005	Hawaii Natural Heritage Program
2. Art Medeiros	June 28, 2005	U.S.G.S. Biological Resources Discipline
3. Jim Jacobi	June 28, 2005	U.S.G.S. Biological Resources Discipline
4. Rick Warshauer	June 28, 2005	U.S.G.S. Biological Resources Discipline
5. Hank Oppenheimer*	June 28, 2005	Maui Land and Pineapple Company
6. Kapua Kawelo	June 28, 2005	U.S. Army
7. Dave Lorence	June 28, 2005	National Tropical Botanical Garden
8. Steve Perlman	June 28, 2005	National Tropical Botanical Garden
9. Ken Wood	June 28, 2005	National Tropical Botanical Garden
10. Marie Bruegmann	July 13, 2005	U.S. Fish and Wildlife Service
11. Vickie Caraway	June 14, 2005	Hawaii Division of Forestry and Wildlife

*Provided new information on this taxon in 2005

List all databases searched:

Name	Date
1. Hawaii Natural Heritage Program	2004

Other resources utilized:

Aedo, C. and F. Muñoz Garmendia. 1997. Twelve new names in *Geranium* L. (Geraniaceae). Kew Bull. 52: 725-727.

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Center for Biological Diversity, Dr. Jane Goodall, Dr. E.O. Wilson, Dr. Paul Ehrlich, Dr. John Terborgh, Dr. Niles Eldridge, Dr. Thomas Eisner, Dr. Robert Hass, Barbara Kingsolver, Charles Bowden, Martin Sheen, the Xerces Society, and the Biodiversity Conservation Alliance. 2004. Hawaiian Plants: petitions to list as federally endangered species. May 4, 2004.

Cuddihy, L.W., and C.P. Stone. 1990. Alteration of native Hawaiian vegetation; effects of

humans, their activities and introductions. Coop. Natl. Park Resources Stud. Unit, Hawaii. 138 pp.

Ellshoff, Z.E., D.E. Gardner, C. Wikler, and C.W. Smith. 1995. Annotated bibliography of the genus *Psidium*, with emphasis on *P. cattleianum* (strawberry guava) and *P. guajava* (common guava), forest weeds in Hawai`i. Cooperative National Park Resources Studies Unit, University of Hawaii. Technical Report 95.

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Hawaii, Department of Land and Natural Resources. N.d.-b. Summary of Title 13, Chapter 123, Game mammal hunting rules, island of Molokai. Division of Forestry and Wildlife, Honolulu. 2 pp.

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Loope, L.L., A.C. Medeiros, and B.H. Gagné. 1991. Recovery of Vegetation of a montane bog following protection from feral pig rooting. Coop. Natl. Park Resources Studies Unit, Univ. Hawaii/Manoa, Dept. Of Botany, Tech. Rept. 77.

Loope, L.L. and A.C. Medeiros. 1992. A new and invasive grass on Maui. Newsletter of the Hawaiian Botanical Society 31: 7-8.

Loope, L.L. 1998. Hawaii and Pacific Islands. Pp. 747-774. In: M.J. Mac, P.A. Opler, C.E. Puckett Haecker, and P.D. Doran (eds.). Status and Trends of the Nation's Biological Resources, Volume 2. U.S. Department of the Interior, U.S. Geological Survey, Reston, VA.

Loope, L., F. Starr and K. Starr. 2004. Management and research for protecting endangered Hawaiian plant species from displacement by invasive plants on Maui, Hawaii. Weed Technology 18: 1472-1474.

Maui Pineapple Company, Ltd. 1999. Pu`u Kukui Watershed Management Area, Kahalawai, Maui, Hawai`i, Fiscal Year 1999 Progress Report, Biannual Report. Submitted to the State of Hawai`i Department of Land and Natural Resources Natural Area Partnership Program, January, 1999.

Medeiros, A.C., L.L. Loope, P. Conant and S. McElvaney. 1997. Status, ecology, and management of the invasive plant, *Miconia calvescens* DC (Melastomataceae) in the Hawaiian Islands. Bishop Mus. Occas. Pap. 48: 23-36.

Medeiros, A.C., L.L. Loope, T. Flynn, S.J. Anderson, L.W. Cuddihy, and K.A. Wilson. 1992. Notes on the status of an invasive Australian tree fern (*Cyathea cooperi*) in Hawaiian rain forests. American Fern Journal 82: 27-33.

Medeiros, A.C., Jr., L.L. Loope, and R.A. Holt. 1986. Status of native flowering plant species on the south slope of Haleakala, East Maui, Hawaii. Coop. Natl. Park Resources Stud. Unit, Hawaii, Techn. Rept. 59:1-230.

Meyer, J.-Y. and J. Florence. 1996. Tahiti's native flora endangered by the invasion of *Miconia calvescens* D.C. (Melastomataceae). Journal of Biogeography 23: 775-781.

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Smather, G.A. and D.E. Gardner. 1978. Stand analysis of an invading firetree (*Myrica faya* Aiton) population, Hawai`i. Proceeding of the Second Conference on Natural Science, Hawaii Volcanoes National Park, pp. 274-288.

Smith, C.W. 1985. Impact of alien plants on Hawai`i's native biota: *in* Stone, C.P., and J.M. Scott (eds.), Hawai`i's terrestrial ecosystems: preservation and management. Coop. Natl. Park Resources Stud. Unit, Univ. Hawaii, Honolulu, pp. 180-250.

Stone, C.P. 1985. Alien animals in Hawai`i's native ecosystems: toward controlling the adverse effects of introduced vertebrates: *in* Stone, C.P., and J.M. Scott (eds.), Hawai'i's terrestrial ecosystems: preservation and management. Coop. Natl. Park Resources Stud. Unit, Univ. Hawaii, Honolulu, pp. 251-297.

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Wagner, W.L., M.M. Bruegmann, and J.Q.C. Lau. 1999b. Hawaiian vascular plants at risk: 1999. Bishop Mus. Occas. Pap. 60: 1-58.

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Wenkam, R. 1969. Kauai and the Park Country of Hawaii. Sierra Club, San Francisco. 160 pp.

Wood, K.R. and S. Perlman. 1997. Maui 14 plant survey final report. Submitted by National Tropical Botanical Garden, October, 1997.

APPROVAL/CONCURRENCE: Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes to the candidate list, including listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all 12-month petition findings, additions of species to the candidate list, removal of candidate species, and listing priority changes.

Approve: Acting _____ 11/16/05
Regional Director, Fish and Wildlife Service Date

_____

Concur: _____ August 23, 2006
Director, Fish and Wildlife Service Date

Do not concur: _____ _____
Director, Fish and Wildlife Service Date

Date of annual review: September 16, 2005
Conducted by: Marie M. Bruegmann, Pacific Islands FWO
Plant Recovery Coordinator

Comments:
PIFWO Review

Reviewed by: Christa Russell Date: September 22, 2005
Plant Conservation Program Leader

Gina Shultz Date: October 14, 2005
Assistant Field Supervisor,
Endangered Species

Patrick Leonard Date: October 14, 2005
Field Supervisor